D2

(12) UK Patent Application (19) GB (11) 2 298 998 (13) A

(43) Date of A Publication 18.09.1996

(21) Application No 9605546.2

(22) Date of Filing 15.03.1996

(30) Priority Data
(31) 9505488 (32) 17.03.1995 (33) GB

(71) Applicant(s)
Rover Group Limited

(Incorporated in the United Kingdom)

International House, Bickenhill Lane, Bickenhill, BIRMINGHAM, B37 7HQ, United Kingdom

(72) Inventor(s)
Jeremy John Greenwood

(74) Agent and/or Address for Service
Alan S Wilson
Rover Group Limited, Gaydon Test Centre, Banbury Road, Lighthorne, Warwick, CV35 0RG, United Kingdom

(51) INT CL^6
H04B 1/38 , H01Q 1/32 , H04B 7/15 , H04Q 7/32

(52) UK CL (Edition O)
H4L LECX L1H10 L1H8B L30
H1Q QHE QKE
U1S S1820 S2204 S2215

(56) Documents Cited
GB 2266028 A EP 0482503 A2 EP 0431640 A2
WO 94/28641 A1 JP 620126726 A US 4647722 A
US 4475243 A

(58) Field of Search
UK CL (Edition O) H1Q QAX QHE QKE QKN , H4L LDRSF LDRSX LECX
INT CL^6 H01Q 1/12 1/14 1/22 1/32 23/00 , H04B 1/03 1/034 1/38 7/14 7/15 7/155 7/26 , H04Q 7/32
ONLINE : WPI

(54) Mobile telephone transceiver for a motor vehicle; same frequency relay

(57) The transceiver has external and internal antennae 14, 16 respectively fitted on the exterior and interior of the vehicle 10, and an amplifier 15 coupled between the antennae 14, 16, whereby a signal received by the internal antenna 16 at a first frequency from a personal mobile phone 17 within the vehicle is amplified and re-transmitted at the first frequency from the external antenna 14 to a remote transceiver 18, and a signal received by the external antenna 14 from the transceiver 18 at a second frequency is amplified and re-transmitted at the second frequency from the internal antenna 16 to the mobile phone 17. An omnidirectional external antenna 14 is mounted on the metal roof skin 12A, a directional internal antenna 16 is mounted on the interior lining 12B of the roof 12, and the amplifier 15 is mounted between the skin 12A and lining 12B. Cross coupling between the antennae 14, 16 is reduced by the metal outer skin 12A and by use of a directional internal antenna 16 positioned towards an edge of the roof, such as the rear edge, and directed towards its centre. Alternatively or additionally to the use of a directional antenna 16, the amplifier 15 may incorporate processing stages for cancelling cross coupled signals.

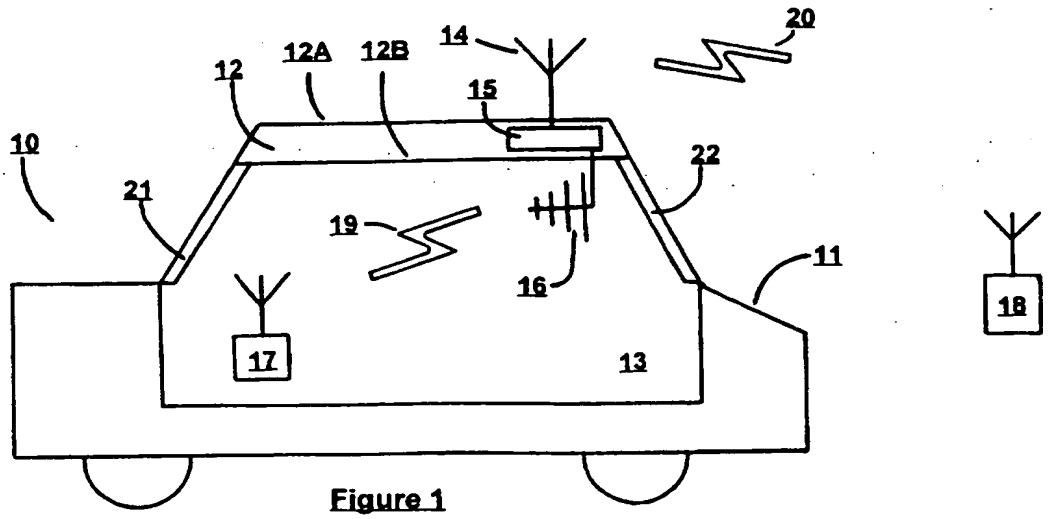

Figure 1

GB 2 298 998 A

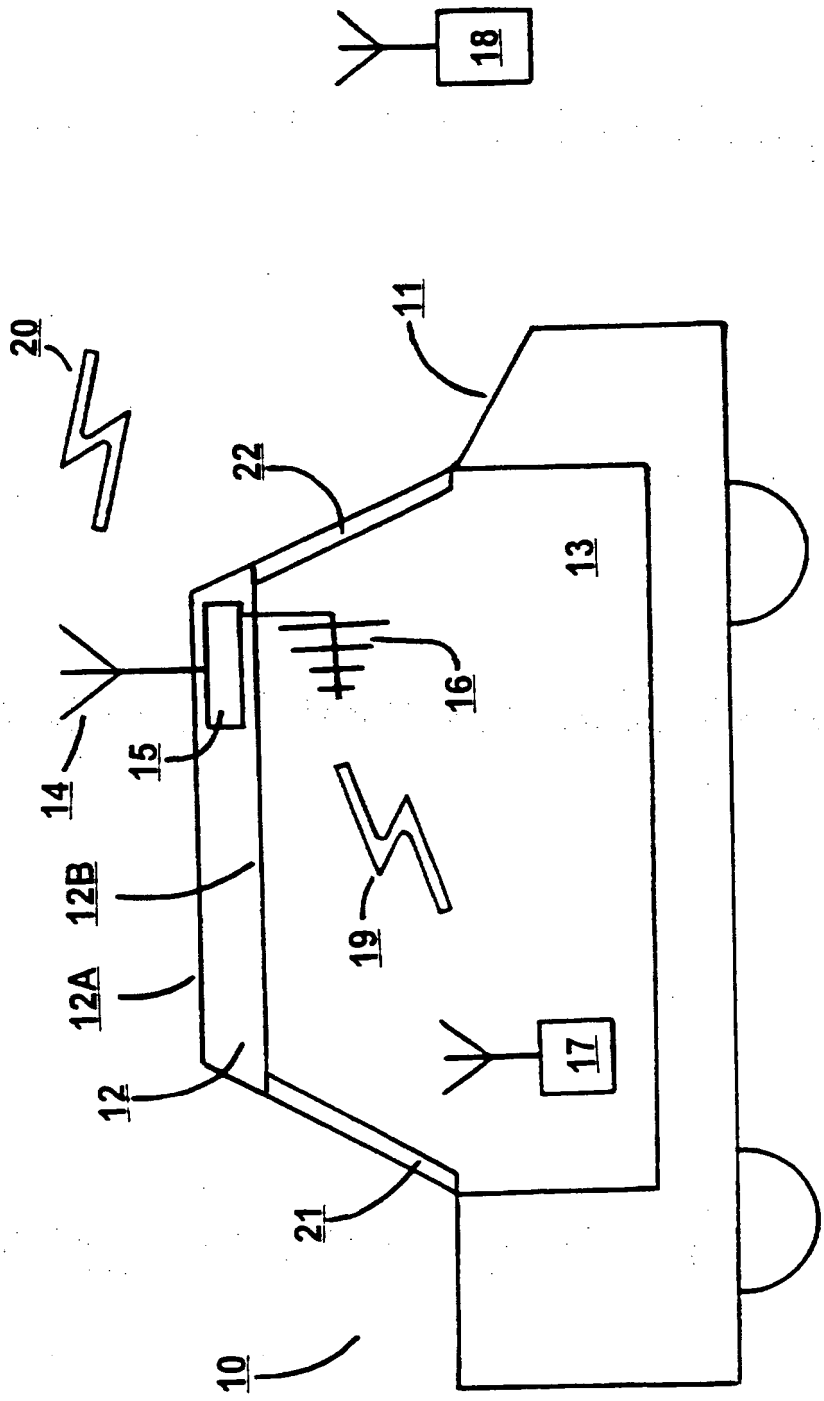

Figure 1

A Mobile Telephone Signal Transceiver For A Motor Vehicle

The present invention relates to a mobile telephone signal transceiver for a motor vehicle.

It is known to use a personal mobile telephone within a motor vehicle. The signals used by such personal mobile telephones both transmitted from within the vehicle and received from without the vehicle can be significantly attenuated, for example by the screening effect of a body-shell made of metal.

It is an object of the present invention to provide improved transmission or reception of personal mobile telephone signals between the passenger compartment of a motor vehicle and a remote transmitter or receiver.

According to the invention there is provided a mobile telephone signal transceiver for a motor vehicle comprising an external antenna fitted on the exterior of the motor vehicle, an internal antenna fitted on the interior of the motor vehicle and an amplifier in communication with both antennae, wherein the transceiver is arranged to receive an exterior mobile telephony signal from a remote transmitter through the external antenna, amplify the external signal in the amplifier and transmit the external signal at the same frequency into the interior of the vehicle through the internal antenna and is further arranged to receive an

interior mobile telephony signal generated from within the vehicle through the internal antenna, amplify the internal signal in the amplifier and transmit the internal signal at the same frequency through the external antenna to a remote receiver.

The internal antenna may be a directional antenna.

Both antennae may be fitted towards one edge of the vehicle roof and the internal antenna may be directed towards the centre of the vehicle roof. For example, the antennae may be fitted one end or side of the vehicle and the internal antenna may be directed towards an opposite end or side of the vehicle in order to reduce mutual interference between the internal and external antennae.

The external antenna may be mounted on a roof of the vehicle such that the roof reduces mutual interference between the external and internal antennae.

The amplifier may be located between the external and internal antennae and may be mounted in part of a roof assembly of the vehicle.

The transceiver may adapted to filter noise from signals received from one antenna before transmission through the other antenna.

Preferably the transceiver is compatible with digital telephony signals. For example, two of the most widely

used formats of digital telephony signals are compatible with the GSM and PCM networks. Digital signals are advantageous over analogue signals in that they are less susceptible to noise which further increases the effectiveness of operation of the transceiver.

The invention will now be described by way of example with reference to the accompanying drawing in which:

Figure 1 shows a schematic diagram of a motor vehicle including a mobile telephone signal transceiver in accordance with the invention.

Referring to figure 1, a motor vehicle 10 comprises a metal body-shell 11 and a roof assembly 12 which in conjunction with a front windscreen 21, a rear windscreen 22 and side windows and doors (none shown) define a passenger compartment 13 of the vehicle 10. The roof assembly 12 comprises a metal roof skin 12A forming part of the body shell 11 and an interior lining 12B.

The vehicle 10 includes a mobile telephone signal transceiver which comprises an amplifier 15 mounted in the roof assembly 12 between the roof skin 12A and the interior lining 12B in communication with an external antenna 14 mounted on the top of the roof skin 12A and an internal antenna 16 mounted on the interior lining 12B.

The external antenna 14 is mounted towards the rear of the roof skin 12A and is omni-directional. The internal antenna 16 is directional and is mounted towards the rear of the passenger compartment 13 and is directed towards the front windscreen 21 at the opposite end of the passenger compartment 13.

The amplifier 15 comprises filtering, amplifying and re-transmission stages and any signal received by one antenna 14, 16 will be re-transmitted from the other antenna 14, 16 at the same frequency. The re-transmitted signal is a 10dB amplification of the received signal.

A personal mobile telephone 17 is shown in the passenger compartment 13 and a network node 18 of a mobile telephony system (not shown further) is shown spaced apart from the vehicle 10.

Internal signals 19 are transmitted from the mobile telephone 17 within the passenger compartment 13 to the internal antenna 16 at a first frequency. After amplification in the amplifier 15, they are re-transmitted as external signals 20 at the first frequency from the external antenna 14 to the network node 18. If the mobile telephone 17 is used outside the passenger compartment 13, its signals are transmitted directly to the network node 18 at the first frequency.

External signals 20 are transmitted from the network node 18 to the external antenna 14 at a second frequency. After amplification in the amplifier 15, they are re-transmitted as internal signals 19 into the passenger compartment 13 at the second frequency where they can be received by the mobile telephone 17 in the passenger compartment 13. If the mobile telephone is being used outside the vehicle 10, the signals from the network node 18 are transmitted directly to the mobile telephone 17 at the second frequency.

The omni-directional nature of the external antenna 14 allows for the movement and changes of orientation of the vehicle 10 in relation to the network node 18. The orientation of the internal antenna 16 is such that it can receive signals 19 from all parts of the passenger compartment 13.

The metal outer skin of the roof 12 significantly reduces cross-coupling between the external and internal antennae 14, 16. This is because the metal roof skin 12A acts as a screen to the signals 19, 20. Because both the antennae 14, 16 are positioned towards the rear edge of the roof 12, and are directed towards its centre, the signals 19, 20 have to travel across the under side of the roof, through the windscreen 21 and then reverse their direction of propagation for cross-coupling to occur.

By making the internal antenna 16 directional, cross-coupling between the antennae 14, 16 is significantly reduced and therefore mutual interference between them is substantially eliminated without adversely affecting the signals 19 between the telephone 17 and the internal antenna 16 to any significant extent.

It will be appreciated that the antennae 14, 16 could equally well be mounted towards the front of the roof assembly 12 or towards one of its sides. The key feature to be included in any other arrangement of the antennae 14, 16 would be to ensure that the internal antenna 16 was directional and positioned such that it would present a suitably difficult signal path for the signals 19 transmitted from the internal antenna 16 to reach the external antenna 14, while preserving a sufficient communications link between the internal antenna 16 and the telephone 17.

It would also be possible to include processing stages in the amplifier 15 to reduce the effects of mutual interference between the antennae 14, 16, either as a supplement to, or in place of, the directionality of the internal antenna 16. For instance, if a signal is received by the amplifier 15 from the internal antenna 16 which comprises a signal Y from the telephone 17 and a significant proportion X of the signal transmitted from the external antenna 14, the signal Y can be obtained by subtraction of the signal X from the combined signal

comprising X + Y. The level of X is proportional to the signal transmitted at the external antenna 14. Therefore X may be calculated sufficiently accurately by the amplifier 15 and subtracted from the received signal. This will further enable mutual interference to be substantially eliminated.

CLAIMS

1. A mobile telephone signal transceiver for a motor vehicle comprising an external antenna fitted on the exterior of the motor vehicle, an internal antenna fitted on the interior of the motor vehicle and an amplifier in communication with both antennae, wherein the transceiver is arranged to receive an exterior mobile telephony signal from a remote transmitter through the external antenna, amplify the external signal in the amplifier and transmit the external signal at the same frequency into the interior of the vehicle through the internal antenna and is further arranged to receive an interior mobile telephony signal generated from within the vehicle through the internal antenna, amplify the internal signal in the amplifier and transmit the internal signal at the same frequency through the external antenna to a remote receiver.

2. A mobile telephone signal transceiver according to claim 1 wherein the internal antenna is directional.

3. A mobile telephone signal transceiver according to claim 2 wherein both antennae are fitted towards an edge of the vehicle roof and the internal antenna is directed towards the centre of the vehicle roof.

4. A mobile telephone signal transceiver according to any one of claims 1 to 3 wherein the external antenna is mounted on a roof of the vehicle such that the roof

reduces mutual interference between the external and internal antennae.

5. A mobile telephone signal transceiver according to any one of claims 1 to 4 wherein the amplifier is located between the external and internal antennae and is mounted in part of a roof assembly of the vehicle.

6. A mobile telephone signal transceiver according to any preceding claim wherein the transceiver is adapted to filter noise from signals received from one antenna before transmission through the other antenna.

7. A mobile telephone signal transceiver according to any preceding claim wherein the transceiver is compatible with GSM signals.

8. A mobile telephone signal transceiver according to any preceding claim wherein the transceiver is compatible with PCM signals.

9. A mobile telephone signal transceiver substantially as described herein with reference to the accompanying drawings.

The Patent Office

L°

Application No: GB 9605546.2 **Examiner:** M J Billing
Claims searched: 1 to 9 **Date of search:** 10 June 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H1Q QAX, QHE, QKE, QKN; H4L LDRSF, LDRSX, LECX.

Int Cl (Ed.6): H01Q 1/12, 1/14, 1/22, 1/32, 23/00; H04B 1/03, 1/034, 1/38, 7/14, 7/15, 7/155, 7/26; H04Q 7/32.

Other: ONLINE : WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB2266028A	(USW PCN) - Fig.3; Abstract	1 at least
Y	EP0482503A2	(TOSHIBA) - Fig.1; Abstract	1,2,6 at least
Y	EP0431640A2	(LARSEN) - Figs.1-3; Abstract	1,2 at least
Y	WO94/28641A1	(TELECOM FINLAND OY) - Figs.2-4; Abstract	1,2 at least
Y	US4475243	(MOTOROLA) - Fig.1; Abstract	6 at least
Y	US4647722	(AISIN SEIKI) - Fig.1	1,2,6 at least
Y	JP620126726	(MATSUSHITA) - & Patent Abstracts of Japan, Vol.11, No.346 (E-556), 12 November 1987, page 104	1,2,6 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

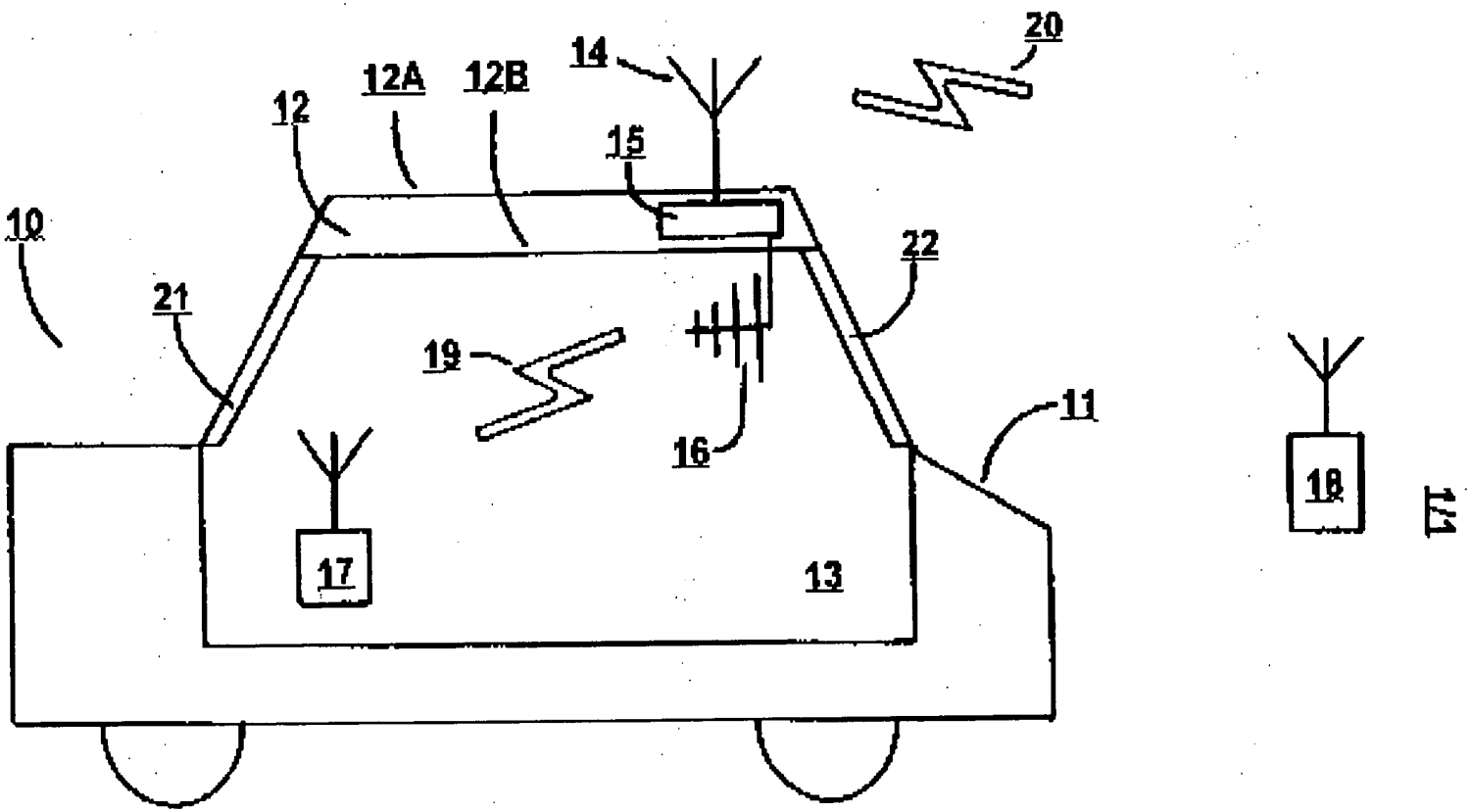

Figure 1